

# NASA TECH BRIEF

## Goddard Space Flight Center



NASA Tech Briefs announce new technology derived from the U.S. space program. They are issued to encourage commercial application. Tech Briefs are available on a subscription basis from the National Technical Information Service, Springfield, Virginia 22151. Requests for individual copies or questions relating to the Tech Brief program may be directed to the Technology Utilization Office, NASA, Code KT, Washington, D.C. 20546.

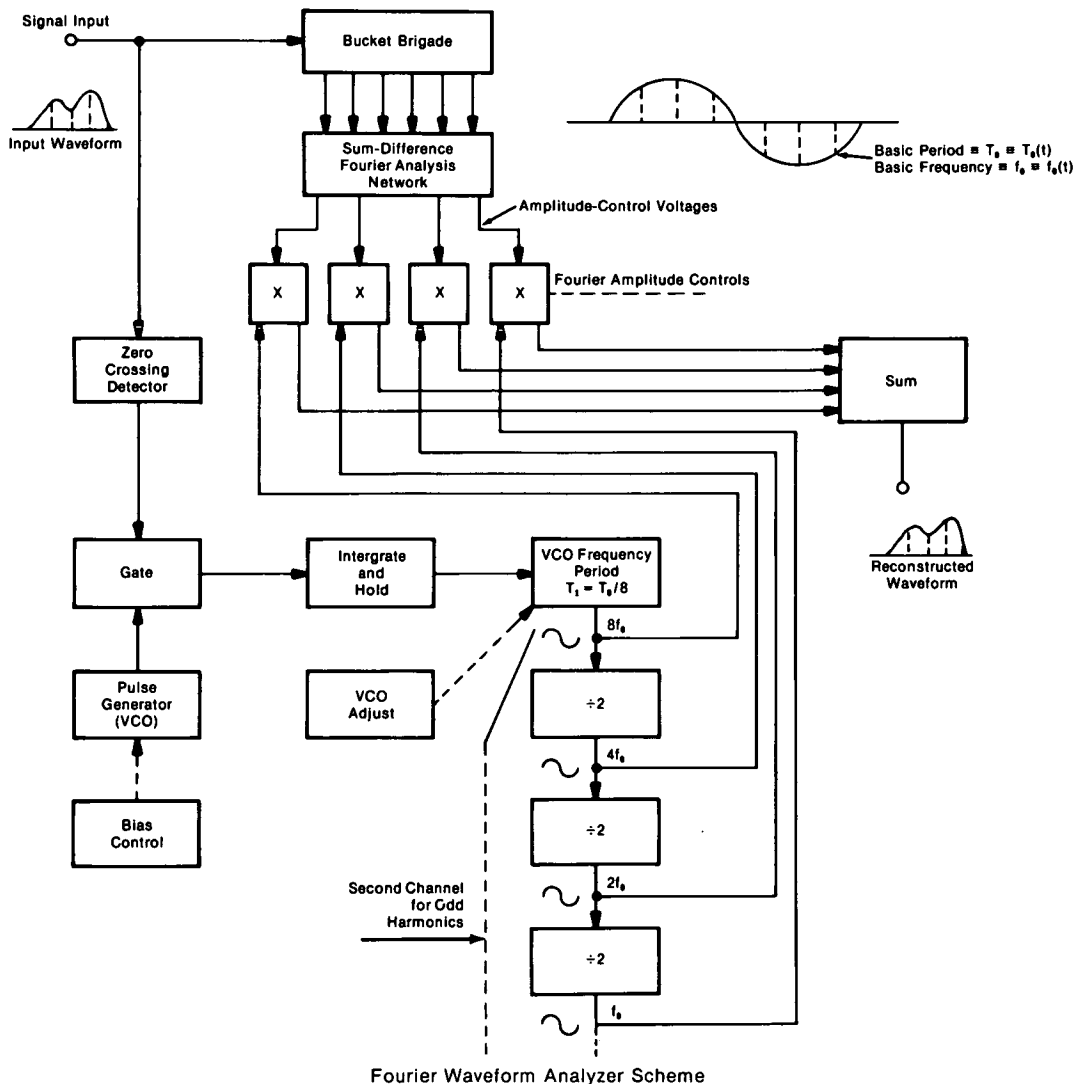
### Fourier Waveform Analyzer

#### The problem:

Complex signal waveforms are analyzed by finding their Fourier components. In one method, a swept narrow band filter is used. In another method, an analog-to-digital conversion is performed followed by a digital computer numerical analysis. Both of these methods are costly and time consuming.

#### The solution:

In a new technique, real-time Fourier analysis is provided by a so-called "bucket brigade" charge-transfer shift register. This device is a small, inexpensive integrated circuit which does analog-to-digital-to-analog conversion, data processing, and time delay.



Fourier Waveform Analyzer Scheme

(continued overleaf)

**How it's done:**

The operation of the Fourier analyzer is as follows (see figure): During the signal input, one quasi-sinusoid of a complex waveform is stored in the shift register. The voltage outputs from the "buckets" are summed and processed in the Fourier analysis network to generate dc voltages proportional to the Fourier coefficients. These voltages control analog multipliers which serve as gain controls. The gain controls govern the amplitudes of sinusoidal signals having harmonic frequency relationships. The sinusoidal signals are generated using standard analog techniques (zero cross-detection, integrate and hold, voltage control oscillation (VCO), frequency division, and the like). As each new quasi-sinusoid of the incoming complex wave is stored in the register, the frequencies and amplitudes of the derived Fourier components are updated. The individual components are then combined in a summing amplifier to reconstruct the original wave.

The analyzer produces dc voltages proportional to the Fourier coefficients as well as a reconstructed

waveform for comparison with the original. By adjusting a bias (gain) on the VCO, the waveform can also be reproduced with a time base different from that of the input waveform. This results in the frequency shifts of each frequency component in the complex wave by some constant ratio.

**Note:**

No further documentation is available. Specific questions, however, may be directed to:

Technology Utilization Officer  
Goddard Space Flight Center  
Code 704.1  
Greenbelt, Maryland 20771  
Reference: B75-10070

**Patent status:**

NASA has decided not to apply for a patent.

Source: John F. Sutton  
Goddard Space Flight Center  
(GSC-11747)